

X. *Part of a Letter from Abbé Nollet, of the Royal Academy of Sciences at Paris, and F. R. S. to Martin Folkes Esq; President of the same, concerning Electricity.*

*Translated from the French, by T. Stack, M. D.
F. R. S.*

S I R,

Read Feb. 11. ^{1747-8.} FOR several Years past Electricity has been my chief Occupation. Last Summer I read three Memoirs at our weekly Meetings, which contained many Particulars on this Subject: But as these were Matters of mere Curiosity, and of no real Use, they almost tired out my Patience. I now send you some Experiments, which I made during the Vacation, which seem to promise at least the being of some Service; but of this you will be the best Judge. I will describe them in the same Order as I made them, and to which I was not led by mere Accident. You know, that when a Vessel full of Liquor, which runs out through a Pipe, is electrified, the electrified Jet or Stream is thrown farther than usual, and is diverged into several divergent Rays, much in the same manner as the Water poured out from a watering Pot. Every body at first Sight will judge, that the Stream is accelerated, and that the electrified Vessel will soon be empty. I was unwilling to rely on the first Appearances, and therefore resolved to ascertain the Fact, by measuring the Time, and the Quantity of the Liquor running out.

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And in order to know if the Acceleration, supposing there was any, was uniform, during the whole Time of the running out, I made use of Vessels of different Capacities, terminating in Pipes of different Bores, from three Lines Diameter to the smallest Capillaries: And I give you in gross the Result of upwards of an hundred Experiments, as it is not so easy a Task to draw a safe Conclusion, as may at first be imagined.

1. The electrified Stream, tho' it divides, and carries the Liquid farther, is neither accelerated nor retarded sensibly, when the Pipe, thro' which it issues, is not less than a Line in Diameter.
2. Under this Diameter, if the Tube is wide enough to let the Liquid run in a continued Stream; the Electricity accelerates it a little, but less than a Person would believe, if he judged by the Number of Jets that are formed, and by the Distance to which it shoots.
3. If the Tube is a capillary one, from which the Water ought naturally to flow, but only Drop by Drop, the electrified Jet not only becomes continued and divided into several, but is also considerably accelerated; and the smaller the capillary Tube is, the greater in proportion is this Acceleration.
4. And so great is the Effect of the electrical Virtue, that it drives the Liquid out of a very small capillary Tube, thro' which it had not before the Force to pass, and enables it to run out in Cases, where there would not otherwise have been any Discharge.

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These last Facts have served as a Basis to my Inquiries. I consider'd all organized Bodies as Assemblages of capillary Tubes, filled with a Fluid that tends to run thro' them, and often to issue out of them. In consequence of this Idea, I imagined, that the electrical Virtue might possibly communicate some Motion to the Sap of Vegetables, and also augment the insensible Perspiration of Animals. I began, by some Experiments, the Result of which confirm'd my Notions. I electrified, for four or five Hours together, Fruits, green Plants, and Sponges dipp'd in Water, which I had carefully weigh'd; and I found, that, after this Experiment, all these Bodies were remarkably lighter than others of the same kind, weigh'd with them, both before and after the Experiment, and kept in the same Place and Temper. I also electrified Liquors of all sorts in open Vessels; and I remarked, that the Electrification augmented their Evaporation, in some more, in others less, according to their different Natures. Wherefore I took two Garden-Pots, filled with the same Earth, and sowed with the same Seeds; I kept them constantly in the same Place, and took the same Care of them, except that one of the two was electrified for fifteen Days running, for two or three, and sometimes four Hours a Day. This Pot always shewed its Seeds rais'd two or three Days sooner than the other, a greater Number of Shoots, and those longer, in a given Time: Which makes me believe, that the electrical Virtue helps to open and display the Germs, and facilitates the Growth of Plants. I advance this, however, only as a Con-

jecture, which deserves further Confirmation; as the Season was already too far advanced, to allow me to make as many Experiments as I could have wish'd: But here are yet other Facts, of which I have a greater Certainty, and which are not less interesting.

I chose several Pairs of Animals of different kinds, Cats, Pigeons, Chaffinches, Sparrows, &c. I put them all into separate wooden Cages, and then weighed them. I electrified one of each Pair for five or six Hours together: Then I weighed them again. The Cat was commonly 65 or 70 Grains lighter than the other; the Pigeon from 35 to 38 Grains; the Chaffinch and Sparrow 6 or 7 Grains: And in order to have nothing to charge upon the Difference that might arise from the Temperament of the Individual, I again repeated the same Experiments, by electrifying that Animal of each Pair, which had not been electrified before; and notwithstanding some small Varieties which happen'd, the electrified Animal was constantly lighter than the other in proportion.

Electricity therefore increases the insensible Perspiration of Animals: But in what Proportion? In the *Ratio* of their Bulks, or in that of their Surfaces? Neither of the one or the other, strictly speaking, but in a *Ratio* much more approaching to the latter than to the former. So that there is no Room to apprehend that a human Person electrified would lose near a 50th Part of his Weight, as it appear'd to me that it happen'd to one sort of Bird; nor the 140th Part, as to the Pigeon, &c. All that I have been hitherto able to learn upon this Head,

is, that a young Man or Woman, from 20 to 30, being electrified during five Hours, lost several Ounces of their Weight, more than they were wont to lose, when they were not electrified. These last Experiments are difficult to pursue with Exactness; because the Cloathing, which cannot strictly be compared to the Hair or Feathers of Animals, retains a good Share of the perspired Matter, and hinders one from forming a good Judgment of the whole Effect of the electrical Virtue.

This forced electric Perspiration is very naturally accounted for, if we consider, that the electrical Matter pervades the interior Parts of Bodies, and that it visibly darts from within outward: For it is very plain, that these electrical Emanations must carry with them whatever they find in the small Vessels, thro' which they are seen, or at least are known, to issue.

This Explanation will, in my Opinion, occur to every one, who has seen the principal *Phænomena* of Electricity. But how shall we account for all the following Effects? All those Animals, whose Perspiration is increased upon their being electrified, all those Seeds, which shoot and grow quicker; all those Liquors, which evaporate; all that Acceleration of Liquids flowing thro' Tubes; all those Particulars, I say, happen in the same manner, when, instead of electrifying those Bodies themselves, they are only held near electrical Bodies of a pretty large Bulk. The Notion which I have, for these three Years past, formed of Electricity, not only affords me an Explication of this, as simple as the former, but I venture to say, it was this same Notion, that led

led me to the Experiments, and made me even foresee their Success.

I am not only satisfied of the Existence of an *effluent* electric Matter, which all the World allows, and which shews itself a thousand Ways; but many convincing Reasons have also assured me, that there is, round every electrified Body, an *affluent* Matter, which comes to it not only from the ambient Air, but likewise from all the other Bodies, whether solid or fluid, that are round about, and within a certain Distance of it. If these surrounding Bodies are of a simple Nature, as a Stone, a Piece of Iron, &c. nothing issues from them but pure electrical Matter: But if they are Animals, Plants, or Fruits, or, in a Word, any organized Bodies, or such, in the Pores of which there is any Substance capable of giving way to the Impulses of the electric Matter; this Matter will, in issuing forth with the great Rapidity, which it is known to have, carry along with it whatever it finds moveable enough to be displaced by it; and by so much will the Weight of the Body be diminished; the same Effect being here produced by the *affluent* Matter, as is produced on electrified Bodies by the *effluent*. If you will please to read over my Essay, what I advance will be better understood. The Increase or Diminution of Perspiration is not a Matter of Indifference to the animal Oeconomy: This new Method of increasing it at Will may possibly prove of Use; it is neither inconvenient nor dangerous; and neither I myself, nor any body else of those on whom I made my Experiments, suffered even the least Inconveniency from it. One feels neither Motion nor Heat differing from that of the natural State

State. Nor did the Animals give any Signs of Un-easiness, while they were electrifying: A little Wea-riness, and a better Appetite, were the only Effects we ever perceived.

As to the Facility of applying this Method, 'tis well known that the electrical Virtue is easily trans-mitted a good way off by Chains, &c. ; and one may easily imagine, that an easy Chair, or even a Bed, sus-pended or supported in a proper manner, will put the most infirm Persons in a Situation to be very com-modiously electrified. But as there is no Necessity to electrify them actually, it will become easier still; for nothing more will be requisite, than to place near them a Basket of old Iron render'd electrical. The commonest Degree of Sagacity will suffice to put this Method in Practice, whenever it is found to be useful.

I shall observe further, that, when I electrify an Ani-mal, I render his Perspiration more copious; and this Effect is universal thro' every Part of it. When I only place it near an electrified Body, it perspires as much. But is its whole Body equally sensible of this Effect? I mean, what exhales in consequence of the Electricity, does it issue from every Part of his Surface? I believe it does not; and that for these Reasons.

If it be the electrical Matter of the Skin that drives out the Matter of Perspiration, by rushing towards the electrified Body, it is natural to think, that this Ef-fect takes place only in the Part out of which the elec-trical Matter issues: Thus the Perspiration, which is electrically forced out, ought to issue from those Par-ts only, which are the most directly applied toward the electrical Body. Let us confirm this by Experiments.

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To an electrified Body I apply a Vessel full of Liquor, which issues Drop by Drop thro' several little Tubes placed in different Parts of its Circumference: These Drops become continued Streams, and are accelerated, as if the Vessel had been electrified: But this Effect is observable on that Side only which faces the electrified Body.

I moisten a thick Sponge with Water, and cut it in two: I weigh these two Halves separately; I join them again, and place the whole near a large electrified Body, so as to make one Half of the Sponge face the Body directly, and the other the contrary Way. After an Electrification of five or six Hours, that Half, which faced the electric Body, was found to be lighter than the other, &c.

Wherefore I think I have good Grounds to believe, that a Man, who presents a Shoulder, or one Side of his Head, to a large electrified Body, perspires more thro' that Part than thro' any other. Add to this, that since these Animals, which I caused to perspire in this last manner, and which had but one Side of their Bodies exposed to the Electricity, lost as much of their Weight, as the others which were thoroughly electrified; it follows, that they perspired as plentifully thro' the exposed Part, as the others thro' the whole Body. Whence we may infer, that, of the two Methods, which I propose for augmenting insensible Perspiration, the latter is the most powerful, and most proper to remove Obstructions from the Pores, or to scour them of any noxious Humours which they may happen to contain. I have the Honour to be, with the greatest, Respect, Sir,

Your most humble and most obedient Servant,
The Abbé Nollet.